#8

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

RECEIVED
SEP 09 2002
GROUP 3600

Applicant:	GOSSELIN, Georges et al.
File No.	14701-1US /MS/SC/ip
Application No.	09/983,043
Filed:	October 22, 2001
For:	BOLTED METAL JOIST AND METHOD OF MANUFACTURING THE SAME
Examiner:	HORTON, Yvonne Michele
Group Art Unite:	3635

RECEIVED
TECHNOLOGY CENTER 3600
02 SEP -6 AM 10:31

LETTER

Assistant Commissioner for Patents
Box Priority Document
Washington, D.C. 20231

Sir:

Applicant submits herewith a certified copy of Canadian priority Application No. 2,271,403 filed on April 22, 1999, on which priority was claimed in the above-identified United States Application.

Respectfully submitted,

Date: September 5, 2002

Michel Sofia, Reg. No. 37,017
SWABEY OGILVY RENAULT
1981 McGill College Avenue #1600
Montreal, Quebec, Canada H3A 2Y3
Tel.: (514) 845-7126

Offic d la prop é int ll ctuell du Canada

Un organisme d'Industrie Canada

Canadian Int ll ctual Pr p rty Offic

An Agency of Industry Canada

Bureau canadien des brevets

Certification

La présente atteste que les documents ci-joints, dont la liste figure ci-dessous, sont des copies authentiques des documents déposés au Bureau des brevets.

Canadian Patent Office

Certification

This is to certify that the documents attached hereto and identified below are true copies of the documents on file in the Patent Office.

Specification and Drawings, as originally filed, with Application for Patent Serial No: **2,271,403**, on April 22, 1999, by **GEORGES GOSSELIN AND VLADIMIR GOCEVSKI**, for "Bolted Metal Joist".

S. Grégoire

Agent certificateur/Certifying Officer

August 27, 2002

Date

Canada

(CIPO 68)
01-12-00

OPIC CIPO

ABSTRACT

A bolted metal joist (in general made out of structural steel and than called steel joists) is a light truss-girder that is resisting solicited bending moments and shear forces by appropriately designed top and bottom cords and web (diagonals and verticals) members. It is assembled with prefabricated members in a shop or at site. The main characteristic separating the proposed steel joist from the steel joists used today is that the elements instead of being welded between themselves at the nodes are connected by bolting. Another distinct characteristic separating the bolted steel joists from the other bolted truss-beams, truss-girders or truss-columns is that at the nodes the elements are connected with a single bolt instead of multitudes of bolts or rivets.

The bolted steel joist comprises a pair of horizontal elongated chord members having a "hat" type cross-section for short and intermediate spans (Fig's.1 and 2) or two buck to buck angles for relatively long spans (Fig.3). The chord members have bolt-holes through the flat bottom. The holes are spaced along their length. The joist's web comprises of diagonals in tension and verticals in compression or diagonals in tension and diagonals in compression connected to the top and bottom chords. The bolts extend trough the registering holes (single bolt per connection) to secure the chords and truss's web members together. The steel joist may support concrete floor. In such a situation the joist may be designed to have composite action with the concrete slab in resisting the loads. The top chord bolts extend trough the registering holes into the concrete slab and act as studs. The top chord of the joists in the case of concrete slab is positioned to accommodate steel deck serving as a form during the poring of the concrete mix.

BACKGROUND OF THE INVENTION

1. Field of the invention

The proposed invention relates to construction of high and low rise commercial, industrial, agricultural and residential buildings for which the roofs, floors and sidings are build by the use of steel joists as primary or secondary structural elements. The invention replaces the use of welded steel joists. In addition, the proposed invention is effectively applicable to reinforcement of roofs and floors in the process of renovation and modernisation of existing structures.

2. Description of the Prior Art

The experience in the use of bolted truss-girders, for construction of buildings and bridges in the past, is large. At the beginning to assemble a truss-girder, connections employing relatively large number of bolts were used. The bolts were later replaced with rivets and then again the bolted connections were reinstated. In the last thirty years welding is commonly used in structural steel connections.

Since 1950's in the construction of the light building structures, the beams, supporting floor or roof slabs are often open web joists - a light type of truss. According to the Canadian Code for steel structures, CAN/CSA-S16.1, Clause 16.2 (or for that mater in an appropriate foreign standard) the steel joist is defined as follow : "Joists are steel trusses of relatively low mass with parallel or slightly pitched chords and triangulated web systems proportioned to span between masonry walls or structural supporting members, or both, and to provide direct support for floor or roof deck. In general joists are manufactured on a production-line basis employing jigs, with certain details of the members being standardised by the individual manufacturer".

"There are many variations of the simply supported joist which has given rise to the definition for *special open-web steel joists or special joists.* These joists are those subjected to specific loading conditions, cantilever joists, continuous joists, joists having special support conditions, and joists used as part of the frame. As defined, tie joists are designed to resist gravity loads only and any connection to a column is to facilitate erection".

However, all the types of the open web joists mentioned above were and are until now exclusively assembled by welding of their web elements to the chords.

For the last fifty years, open web steel joists were manufactured in shops. Over many years of production, some technological advances, as well as the know-how of the industry, mainly gained from experiences on the field, made it possible to improve the manufacturing techniques and methods. Yet, as far as the basic manufacturing process itself is concerned, little has changed: it still requires an imposing number of welders who assemble the joist manually with the help of templates.

In the long list of patents related to steel elements and connections there are several which may concern the aspect of the present invention, however, a closer investigation allows to conclude that they do not or can not be considered as applicable for reference. The following are the comments on some of the already existing patents:

US patent No. 513,187 – January 23, 1894

- The Joly's "Lattice truss girder" has one bolt-rod that extends trough the vertical member and provide attachments of the vertical, chords (top and bottom) and diagonals. The rods are solicited on shear as well as tensile forces. In the proposed joist, one bolt is providing a connection of the top chord vertical and diagonal at the top and one bolt is providing a connection of bottom chord, vertical and diagonal at the bottom. The bolts in the connection are solicited with the shear forces only since the vertical is such that does not allow development of any tensile force in the bolts.
- The top and the bottom chords in Joly's "Lattice truss girder" are constructed of a single or several overlaid plates depending on the magnitude of the chord's tensile or compression forces (related to the span and the loads of the girder). For such members the lateral-torsional stability requirements for the compression chord and the effect of local bending between nodes oblige use of very strong (thick) plates or several plates. At the time of the Joly's invention this was appropriate solution, however at present it has two drawbacks: (i)

very uneconomical design in the case of single plate, (ii) uneven support in the case of multiple plates. The latter can not accommodate steel decks in a standard steel joists floors without special accommodations (extremely expensive solution).

- Verticals in Joly's invention are limited to tubular members only for purpose of allowing the placement of rods.

US patent No. 1,311,820 – July 29, 1919

As stated by the author (Jones) "The invention relates generally to metallic building structures and more specifically to an improved construction for a structural member which may be variously employed as a column, strut member and the like". The invention is not applicable for the design of steel joist, truss girders or any elements solicited in bending. The structural element of Johns patent is composed of weary strong chord members (typical for columns or struts) interconnected with serie of tongues cut from the web portions, welded or riveted. This type of elements behave well under axial loads, however, when used as joists, or any other flexural element, the eccentricity of diagonals in the nodes creates bending moments in the chord. The capacity of diagonals and in consequences joist wen used for such purpose would be limited by the thickness of the cut of web plate.

US patent No. 1,839,178 – December 29, 1931

The Rebman invention relates to a metal joist construction. As described by the inventor, "The invention comprehends the provision of a metal joist having upper and lower chord members, tension members extending diagonally between these chord members and compression bars connecting the cord members and retaining the tension members in assembled relation therewith, in which the special construction of the tension members and the chord members provides for the use of reduced ends on the compression bars adapted to extend through registering openings in the tension and chord members so that the swaging of the reduced ends of the compression bars will rigidly assemble these parts together". The verticals in the Rebman's claim are limited to rods which are not bolted, however the rods extend similarly to the Joly's patent onto the cords going through the diagonal plates. The connections verticals-diagonals-chords are secured by swaged terminals.

US patent No. 3,800,490 – April 2, 1974

The invention by Conte is not related to individually designed steel joist or steel truss girder. As the title defines it is a invention of "Building structure for floors and roofs".

- The Conte's invention comprises of primary and secondary truss assemblies. "The structure forms a truss-like beam comprised of primary and secondary truss assemblies. The primary truss assembly includes diagonal web elements which are secured to a bottom chord. The secondary truss assembly includes elements nested within and engaged upon the primary web elements and secured together by bottom chords". Or, the top chord (part of the secondary truss assembly) is a steel deck that "includes a plurality of transversely

extending corrugations". The truss action is assured only when the deck assembled to the secondary truss elements is present, that is, the truss is not able to carry the loads without the composite deck action. Therefore, the structural system is not slab supported by steel trusses but it is rather a orthotropic steel deck assembly.

- The bottom chord connections proposed by Conte includes saddles with parabolic configuration shop welded to the upper surface of the chord. The saddle accommodate web elements (V-shaped diagonals). The diagonals are continuous in the connection and they follow the parabolic shape of the saddle.
- As claimed by Conte: The primary truss wont be in a position to span even relatively short spans without secondary truss elements "nesting" within their diagonals. The buckling stability of the V-shaped primary truss diagonals in compression is very low. They cannot exceed certain length without being retained laterally by the secondary truss elements.
- At the top chord connections a single bolt wont be able to transfer the shear forces without the provision for "nesting" of the secondary truss assemblies into the primary truss-like beam. The spacing of the trusses is to large. Even standard column spacing will produce overwhelming shear forces in the bolts, as well large deflections.

SUMMARY OF THE INVENTION

The technological advances in both, manufacturing tools and computer software today are able to provide for the bolted steel joists an automated and efficient production. The high precision in the fabrication of the joists is an essential part of their successful application in practice. The required tolerances in the bolt to hole diameters as well the lengths and forming of the diagonals and verticals play critical part in the deflection of a loaded joist. Therefore, a precise manufacturing process is a must.

The strategy is relatively simple. Bolting instead of welding the members of the joist allows relatively simple automated process. Complex robotics usually associated with assembly lines is not necessary. The production line contains few tools that are usually a standard equipment in any steel workshop. The process can be computerised with a simple software, hence only a small number of people will be required to operate the production.

An automated and efficient production in the case of the welded steel joists is technically almost impossible and in terms of investment prohibitively costly.

In fact, by introducing bolted connections, then re-engineering the manufacturing process of the steel joists and integrating in it the new automated production technologies a way is found to make an open web steel joist of superior quality and at a better price than the welded steel joists.

The advantages, both, technological and financial, in the construction of new steel buildings, where steel joists are the floor or roof supporting members is evident when bolted steel joists are used. The main reason is the automated production.

The advantages of the bolted steel joists can be seen also in the refurbishing of floors and roofs in the renovation or strengthening of existing buildings. The bolted joist can be assembled on site

right under the floor. Therefore the reinforcement of any floor can be done without removing the piping and electrical equipment installed at the ceiling. Also, the pre-loading of the joists which is essential in the appropriate load distribution among the existing floor elements and the added joists is possible by firs assembling the members then lifting to compensate for dead loads and finally tightening the bolts.

The bolted steel joists once properly fabricated can be assembled at the construction site with non highly qualified labour. Hence, the advantages in transportation are evident. The required volume is largely reduced and the distortions and on site corrections of the joists, very common in the transportation of welded steel joists is non existent.

The proposed connections are simple single bolt connections in which the truss web elements (diagonals and vertical) are secured with the "hat" type chord members after the flat bottom of the upper chord or the flat top of the lower chord. In the case of joists where two buck to buck angles are used as cord members the truss web elements are secured to the cords by directly connecting them to the vertical legs of the angles. There is no need of gussets or any local reinforcements of members. They differ from the common multiple bolts or rivets connections. This type of connection was never proposed in a case of steel joists. A single bolt connection of the type proposed by this invention was never proposed or used in the concept of the standard truss, or truss-girder, or latticed truss girder, or etc

The general objective of this invention is the introduction of bolted open web metal joists for which the simplicity of the connections allow significant improvement in the manufacturing techniques and guaranties the performance of the joist.

The arrangements of the members in the nodal connections where the web is composed of diagonals and verticals is such that the vertical component of the member forces remains in equilibrium without any mechanical means (it is not transferred by the bolt) and only the horizontal component has to be secured by bolt. This type of connection is a result of an exhaustive numerical analysis of various nodal connections and numerous tests performed at full scale assembling.

The following advantages arise from the proposed invention:

1. A metal joist that can be obtained at an appreciable low cost mainly by avoiding any welding at the connections; that is, introduction of bolted connections of type sought by this invention;
2. The joist made with web members of any shape provided the ends of the members are flattened and bent;
3. The joists are not distorted as a result of the manufacturing process, therefore, to avoid costly straightening during and after their fabrication (assembling).
4. The joist which assembly parts can be added or removed according to the use intended and without difficulties, essential in reinforcing of not easily accessible floors;
5. The joist that can be shipped unassembled which means an appreciable reduction in transportation cost;
6. The joist with parts made in shop that can be painted prior to assembly which allows pollution-less process;

DESCRIPTION OF THE INVENTION

In one embodiment the invention relates to a steel or any other metal joist construction. It comprehends the provision of a metal joist having top and bottom chord "hat" type members, tension diagonals extending between the chords and compression verticals pressing the diagonals to the chords. The three elements (the chord, the diagonal and the vertical) at each node are secured together by a bolt acting only in shear. The vertical compression elements (bars, tubes, HSS with rectangular or square cross sections, V-sections, U-sections) are formed at their ends to press to the end of tension diagonals and indirectly to the cords. This arrangement ensure an equilibrium of the diagonals and verticals in vertical direction, the only force to be carried by the bolts is the horizontal component in the node.

In second embodiment the invention comprehends the provision of a metal joist having top and bottom "hat" type chord members, tension and compression diagonals extending between the chords. The three elements (the chord, the tension diagonal and the compression diagonal) at each node are secured together by a grip bolt acting in both shear and axial tension.

The third embodiment comprises of a top and a bottom chords assembled each by two buck to buck angles. The web members are diagonals and verticals or diagonals only formed in such a way to feet between the vertical legs of the chord angles and are secured at each node with a single grip bolt after the chords.

In fourth embodiment the invention comprehends the provision of metal joist of types described in either of the previous two embodiments, concrete slab supported and acting in a composite manner with the steel joist, extended, in the concrete slab, bolts provided to ensure the top chord connections with the web members and act as studs for the composite action between the concrete slab and the metal joist.

All of the above embodiments are characterised by single bolt connections. The steel joists where the web is composed with diagonals only or the chords are assembled with two angles, the bolts are grip type in order to control the deflection of the loaded joist. In addition the top chords in the composite concrete-joist floors are connected to the web members with a single bolt (stud-bolt) prolonged to enter into the concrete slab and having a nut at the top.

In the drawings:

- Fig.1 shows a metal joist having top and bottom chord members ("hat" type), tension diagonals extending between the chords and compression verticals pressing the diagonals to the chords ...
- Fig.2 shows a metal joist having top and bottom chord members ("hat" type), tension and compression diagonals extending between the chords ... etc.
- Fig.3 shows a metal joist having top and bottom chord members (two buck to buck angles) tension and compression diagonals extending between the chords...
- Fig.4 shows composite concrete slab and the metal joist...

In the all embodiments: (detailed description should follow)

The upper (top) and the lower (bottom) chords 1 (numbers correspond with those in the drawings) consists of a strait "kappa" bar having plurality of spaced drilled or punched holes 2. The chords are oriented towards each other with their flats 3, or in a case when the joists support concrete floor both chords are positioned upward with their flats.

A plurality of tension bars (diagonals) are mounted between the top and bottom chords.....(detailed description of each element shown on the drawings)

BOLMETCO inc.; Bolted metal joists; requisiti n of patent

Draft document prepared by
Vladimir Gocevski Ph.D., ing.

This document is intended to assist Tertium International inc. in their assessment on possibility to obtain a patent of the proposed bolted steel joist. It contains two parts; (1) Sought of Patent on the invention written in an appropriate for this purpose format, and (2) discussions (comments) and comparison of the proposed invention with the existing (similar) patents.

BOLTED METAL JOIST

Inventors: Georges Gosselin, Otterburn Park (Quebec) Canada
Vladimir Gocevski, Beaconsfield (Quebec) Canada

Assignee: BOLMETCO inc. Otterburn Park (Quebec) Canada

References Cited

Canadian Patents

1. Wackernell, at al.	CA patent No. 1,131,872 – September 21, 1982
2. Dale	CA patent No. 1,097,018 – March 10, 1981
3. Wood, at al.	CA patent No. 947,030 – May 14, 1974
4. Bolton at al.	CA patent No. 581,580 – August 16, 1953
5. Rietz	CA patent No. 403,749 – March 3, 1941
6. Maxwell	CA patent No. 280,404 – May 22, 1928

United States Patents

1 Joly –	US patent No. 513,187 – January 23, 1894
7. Jones	US patent No. 1,311,820 – July 29, 1919
8. Rebman (joist)	US patent No. 1,839,178 – December 29, 1931
9. Conte	US patent No. 3,800,490 – April 2, 1974
10. Hadley	US patent No. 3,138,899 – October 15, 1959
11. Jackson	US patent No. 4,333,293 – June 8, 1982
12. Jensen	US patent No. 4,366,659 – July 8, 1980
13. Perlman	US patent No. 4,295,318 – October 20, 1981
14. Lawrence	US patent No. 4,200,946 – May 6, 1980
15. Cody	US patent No. 4,102,108 – July 25, 1978
16. Cody	US patent No. 4,106,256 – August 15, 1978
17. Love et al.	US patent No. 3,793,790 – February 26, 1974
18. Cape	US patent No. 3,336,718 – August 22, 1967
19. Chamberlain	US patent No. 1,190,725 – July 11, 1916

CLAIM

What is claimed is:

1. A steel (or any metal) open web joist, comprising a straight elongated bar (hat type) forming an upper (top) chord member, a strait elongated bar (hat type) forming a lower (bottom) chord, tension bars extending in diagonal relation between the lower chord member and the upper chord member, each tension bar having angularly extending foot position seated against said chord members and provided with drilled or punched openings (holes) in registry with openings in said chord members, compression bars having Z form mounted in substantially perpendicular relation between said chord members and having right-angularily extending foot position seated against said tension bars and provided with drilled or punched opening (holes) in registry with openings in said chord members as well as said tension (diagonal) members, bolts trough said registering openings for permanently securing said compression bars, tension bars and chord members in assembled relation. Compression bars having a Z form and made of any shape with the ends pressed and bent in the way that allows an equilibrium of vertical components without local deformations in the node (Fig. ?).
2. Metal open web joist, comprising a straight elongated bar (hat type) forming an upper (top) chord member, a strait elongated bar (hat type) forming a lower (bottom) chord, tension bars extending in diagonal relation between the lower chord member and the upper chord member, each tension bar having angularly extending foot position seated against said chord members and provided with drilled or punched openings (holes) in registry with openings in said chord members, compression bars extending in diagonal relation between the lower chord member and the upper chord member, each compression bar having angularly extending foot position seated against said chord members and provided with drilled or punched openings (holes) in registry with openings in said chord members, as well as said tension (diagonal) members, special bolts (grip bolts filing the entire bolt holes or openings) trough said registering openings (preventing any slippage) for permanently securing said compression bars, tension bars and chord members in assembled relation.
3. Metal open web joist, comprising a strait elongated double bar (two buck to buck angles, channels, or any other sections) forming an upper (top) chord member, a strait elongated double bar (two buck to buck angles channels, or any other sections) forming a lower (bottom) chord, drilled or punched openings on the vertical legs of the angles or webs of

channels in the rods forming the top and bottom chords, tension bars extending in diagonal relation between the lower chord member and the upper chord member, each tension bar having extending end position with drilled or punched openings in registry with openings in chord members, compression bars extending in diagonal or vertical relation between the lower chord member and the upper chord member, each compression bar having extending end position with drilled or punched openings in registry with openings in chord members bolts trough said registering openings for permanently securing said compression bars, tension bars and chord members in assembled relation

4. Metal joist as described in clauses 2, and 3, with their top chord inverted with its flat bed to provide support for a corrugated steel deck or other concrete slab form-work, with bolts trough said registering openings for permanently securing said compression bars, tension bars and chord members in assembled relation with bolts at the upper chord extending into the future concrete slab to act as studs and provide composite action of the concrete slab-steel joist assembly.
5. Studs designed to permanently secure compression bars, tension bars and top chord member acting as a bolt and assuring in the same time a concrete-steel composite action by its design.
6. Two inclined metal joists as described in clauses 2 or 3, two vertical columns, vertical end plates secured by welding to the upper and lower chords at both extremities of each joist, bolts trough registering openings in the plates for permanently securing two joist among themselves at one end of each joist, bolts trough registered openings in the plates for permanently securing two joists after the vertical columns at each end of the already assembled joists sloping in opposite directions and connected among themselves with vertical end plates. The assembled elements form single bay single story steel frame with plane H- cross-section or HSS columns and two slops roof joist.
7. Automated production technology in the fabrication of the bolted open web steel joists.

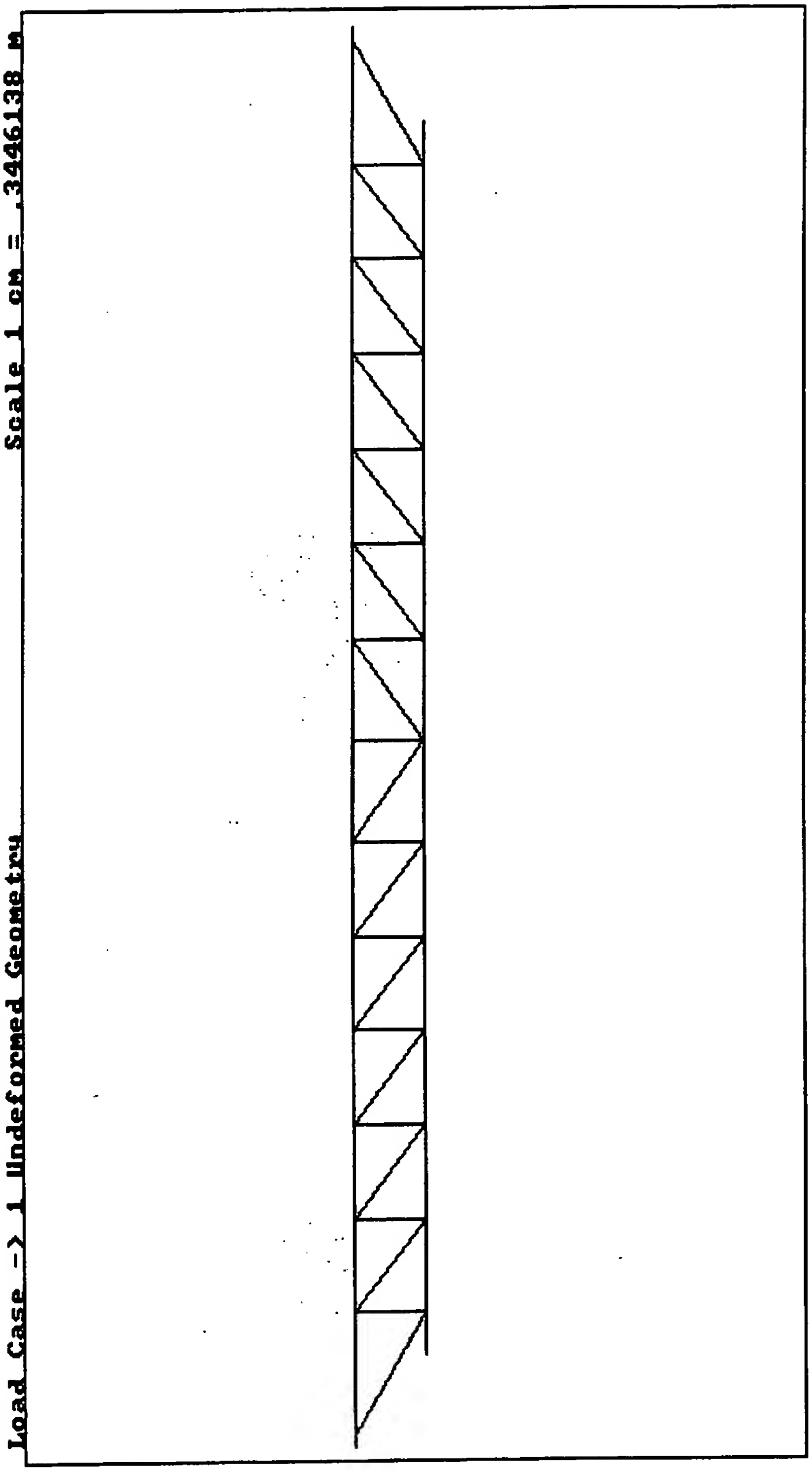
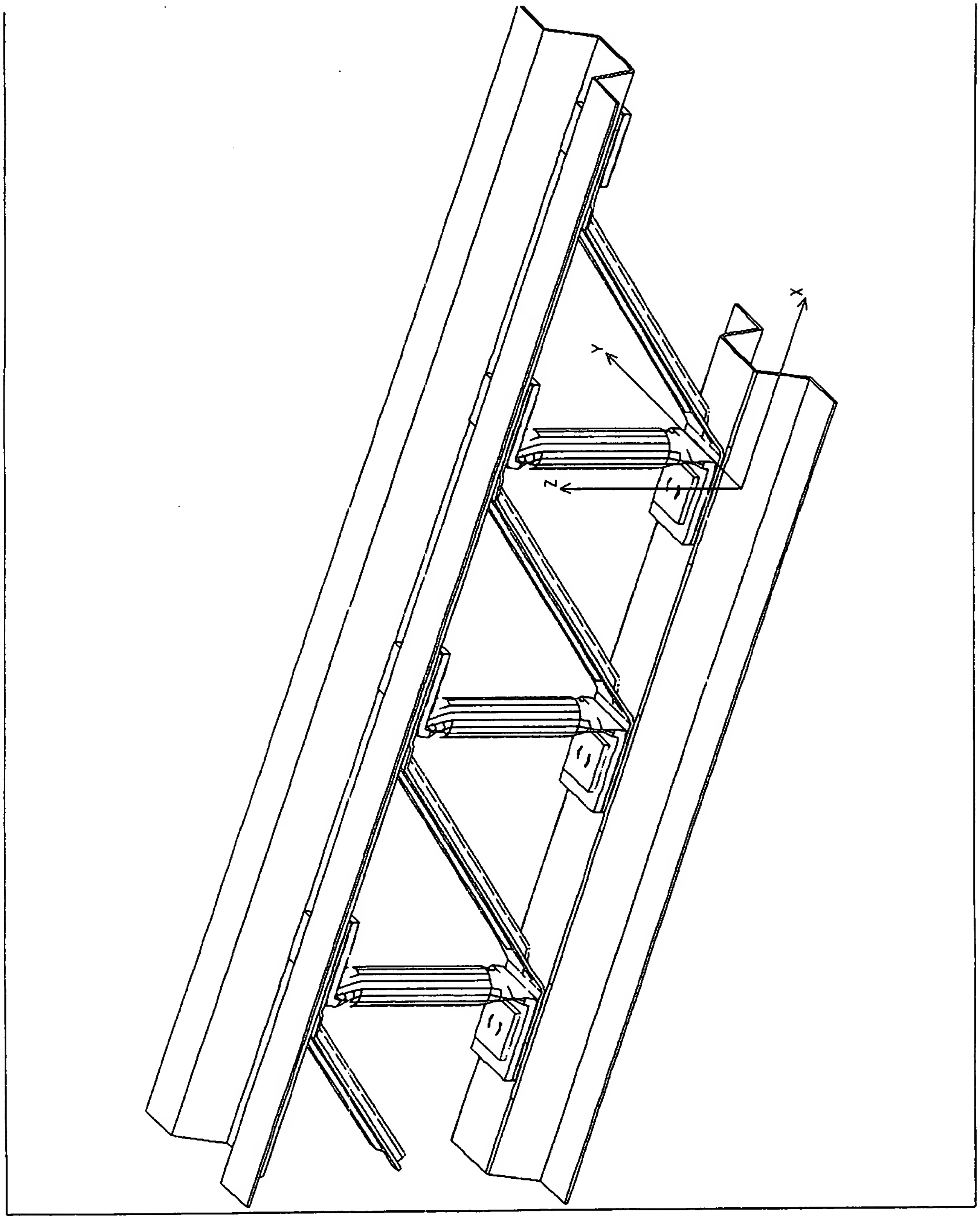


Fig. 1

Fig 1/1



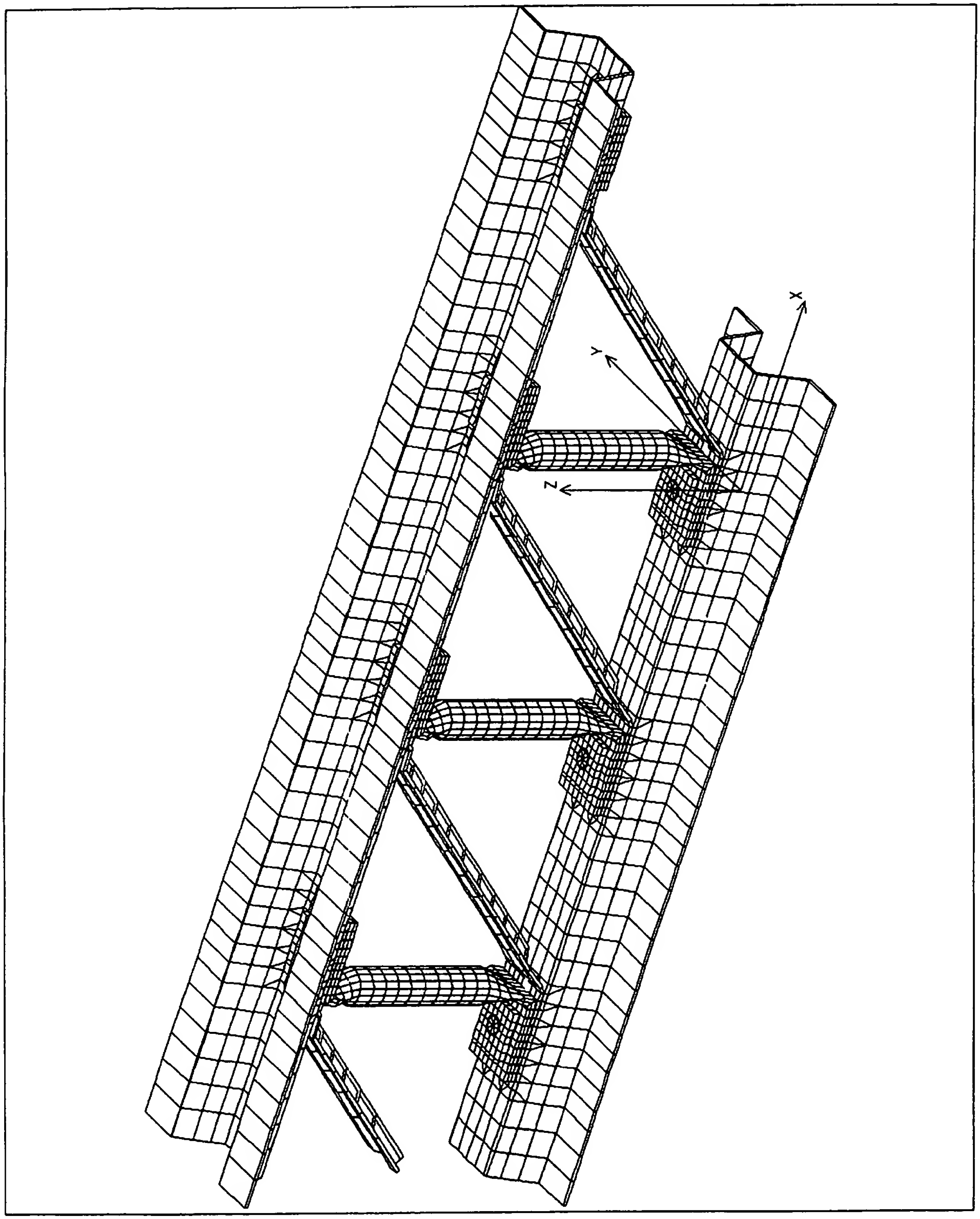
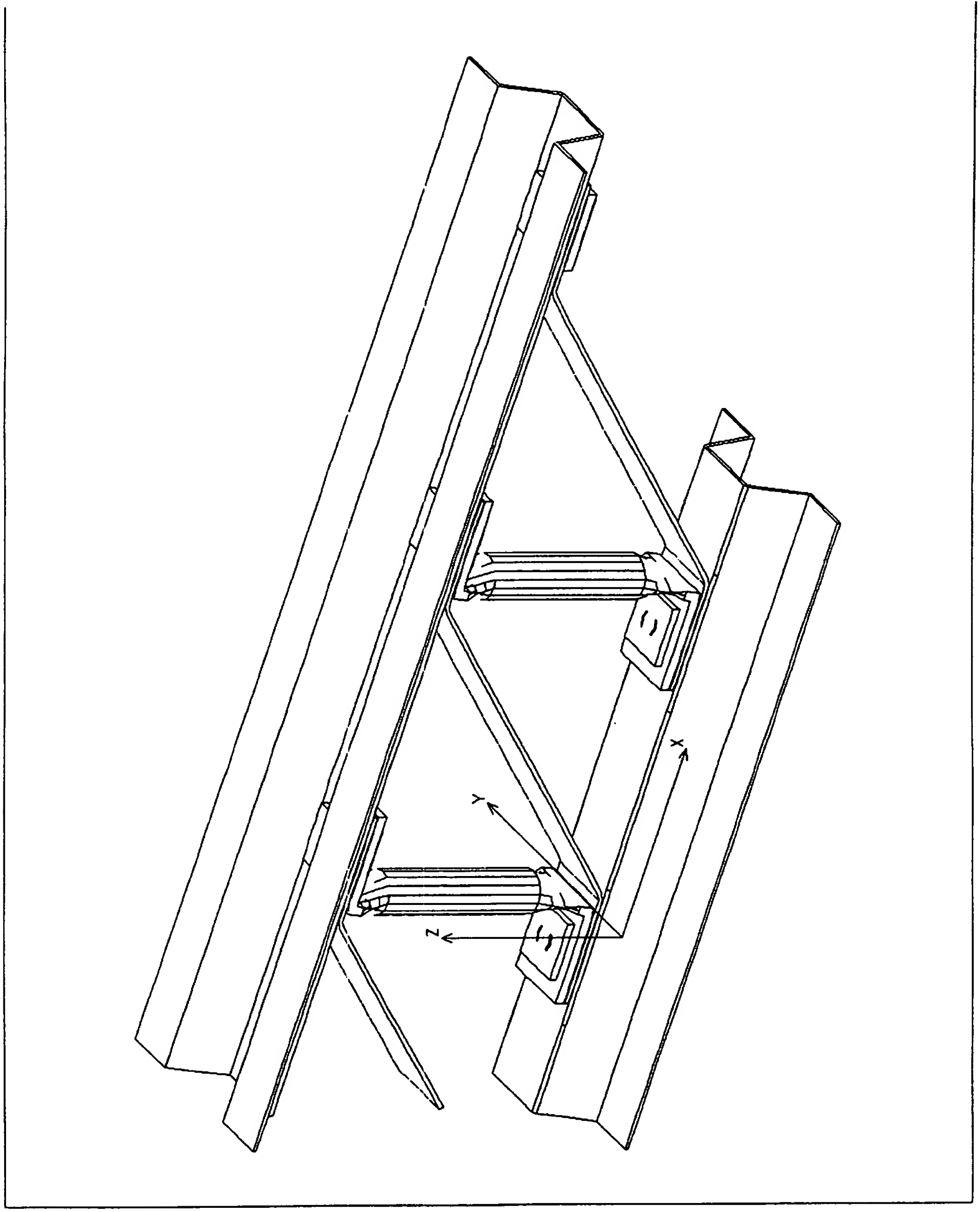


Fig: 12

Fig 1,3



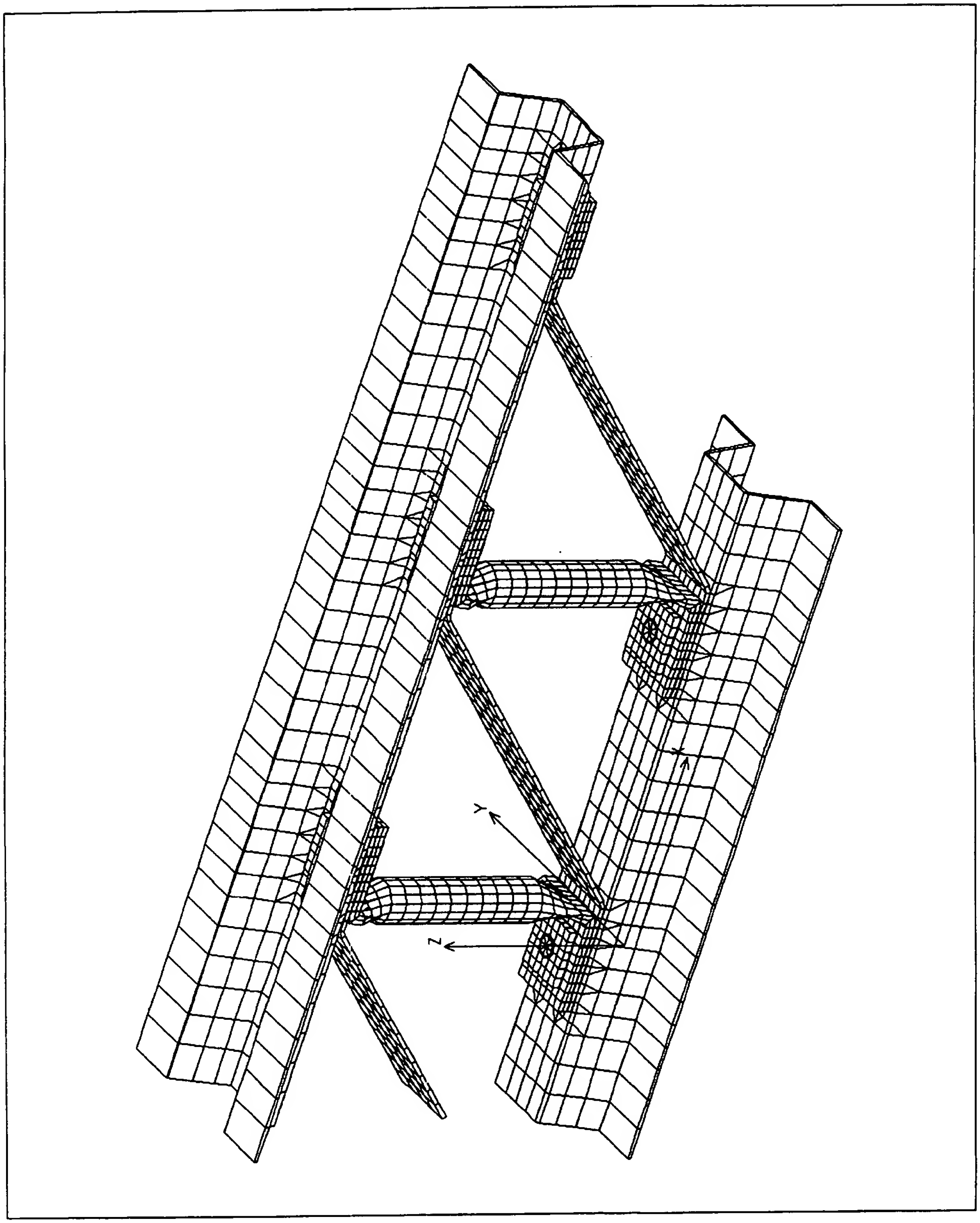


Fig 14

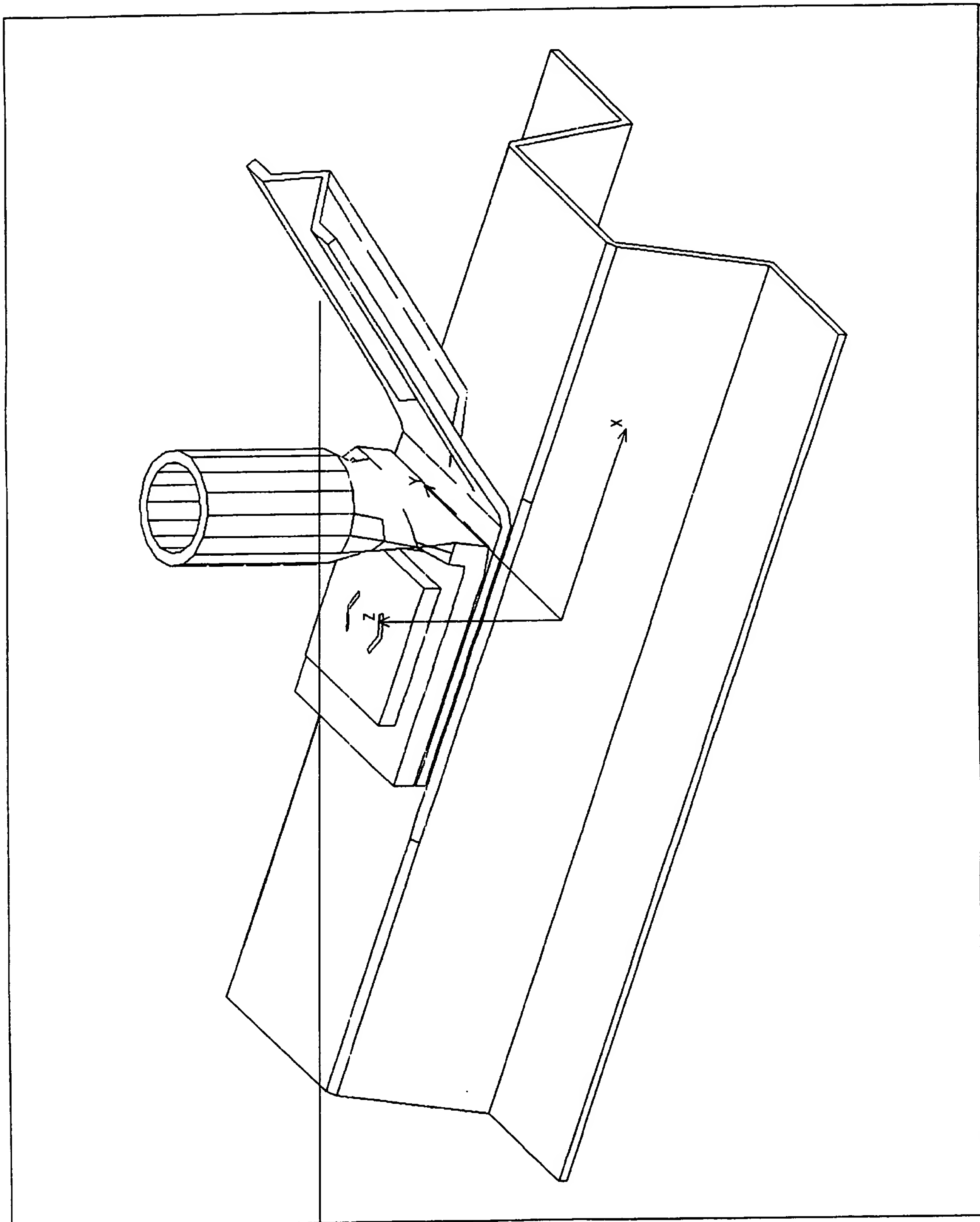


Fig. 15

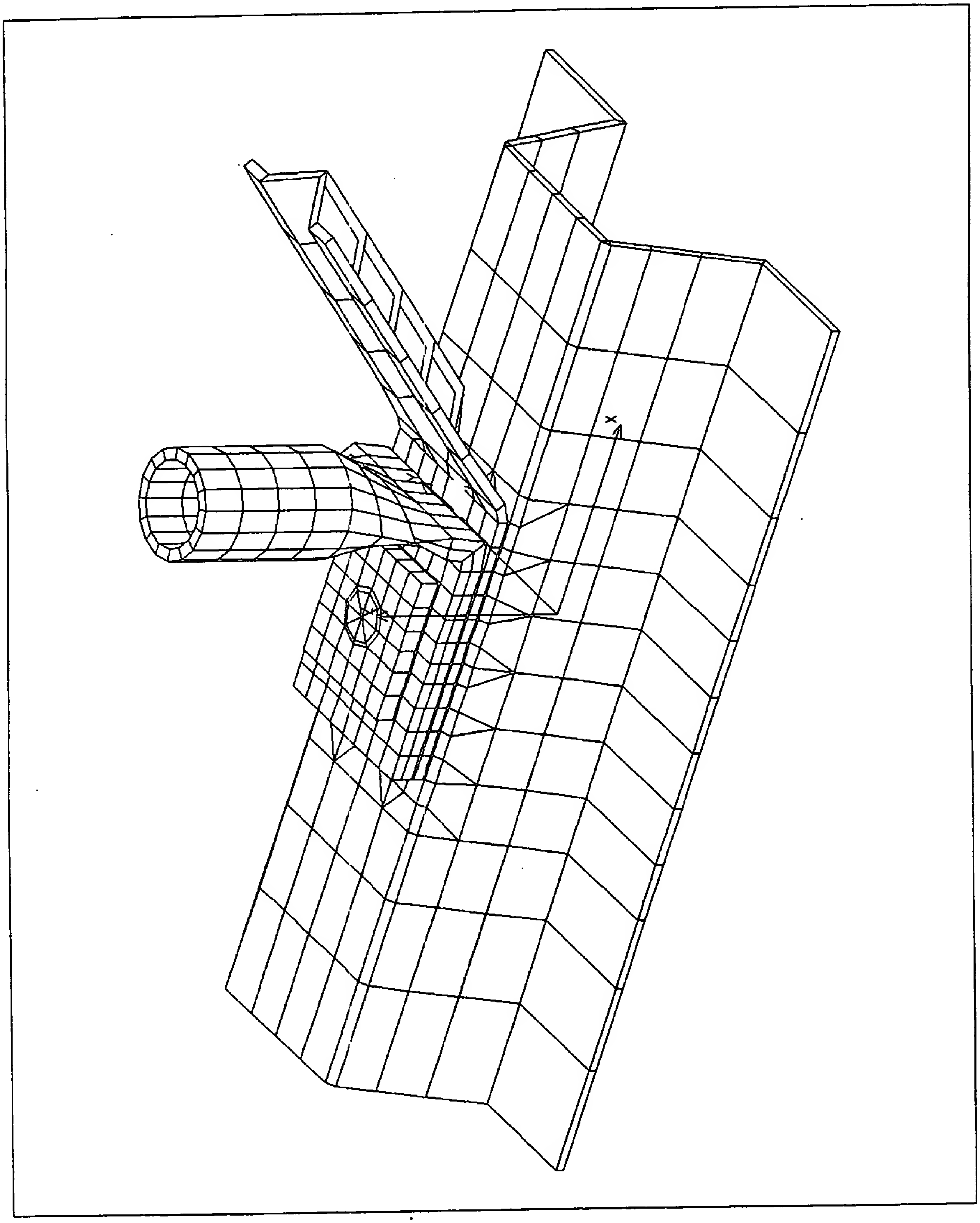


Fig. 16

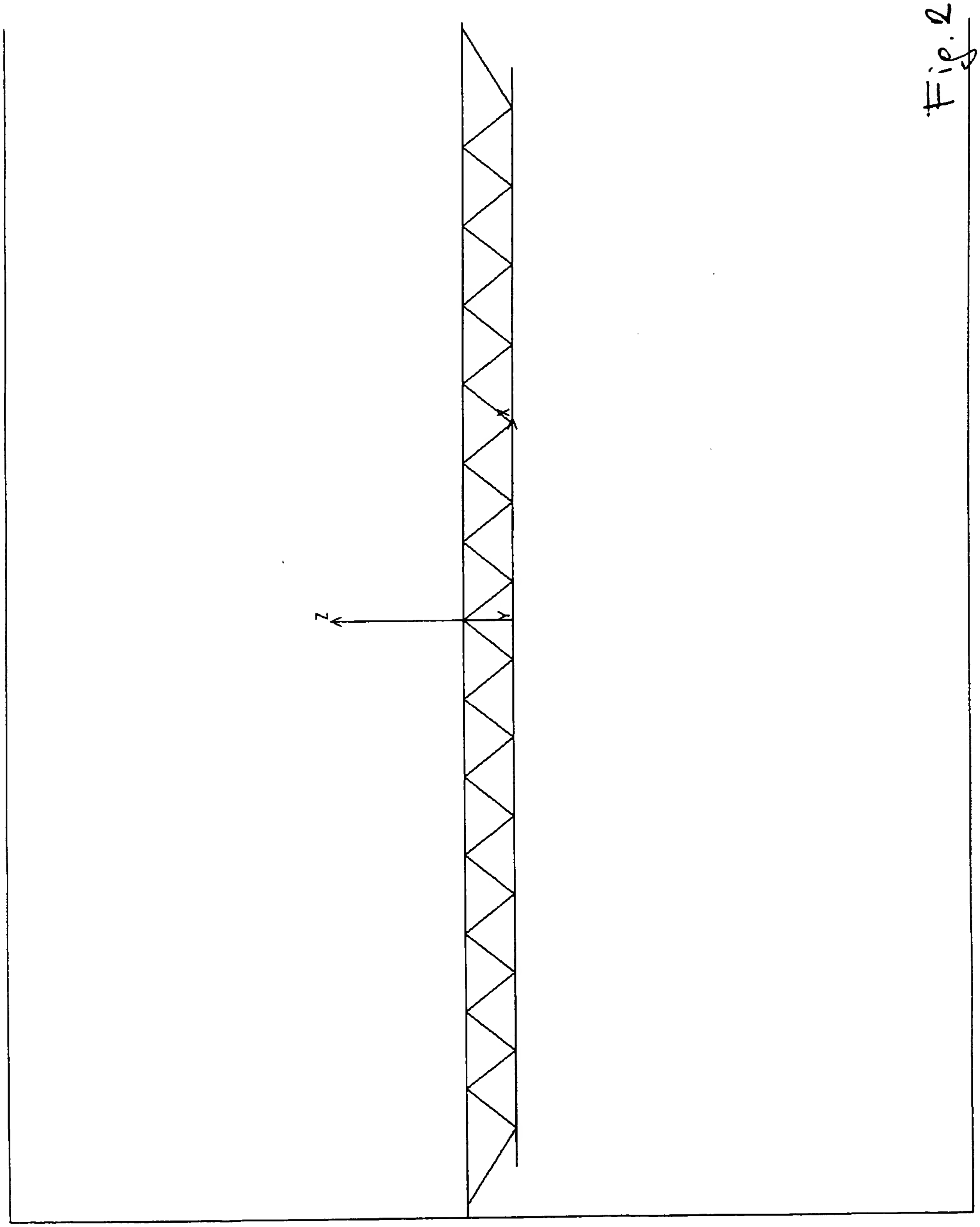


Fig. 2

Fig. 21

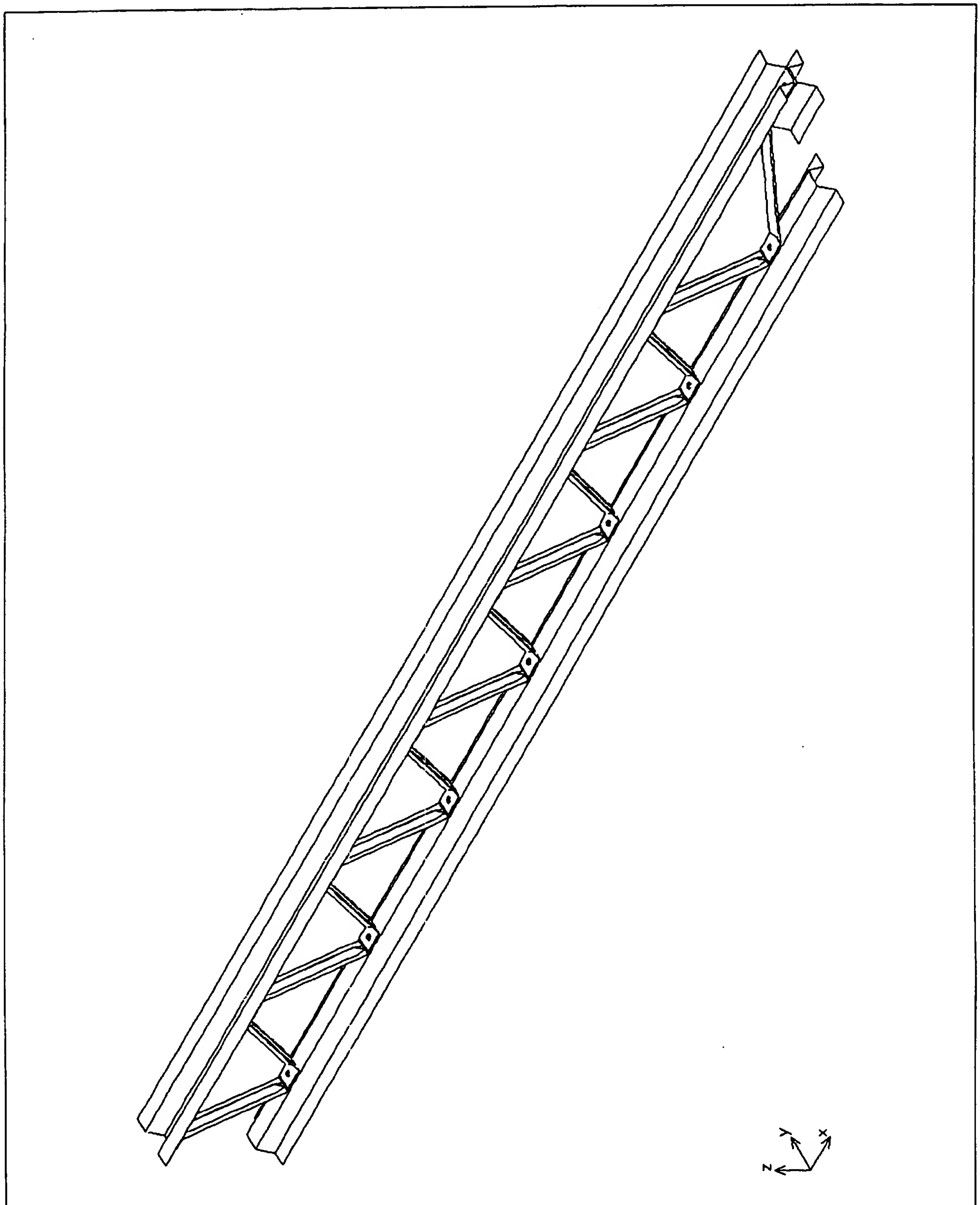


Fig. 2,2

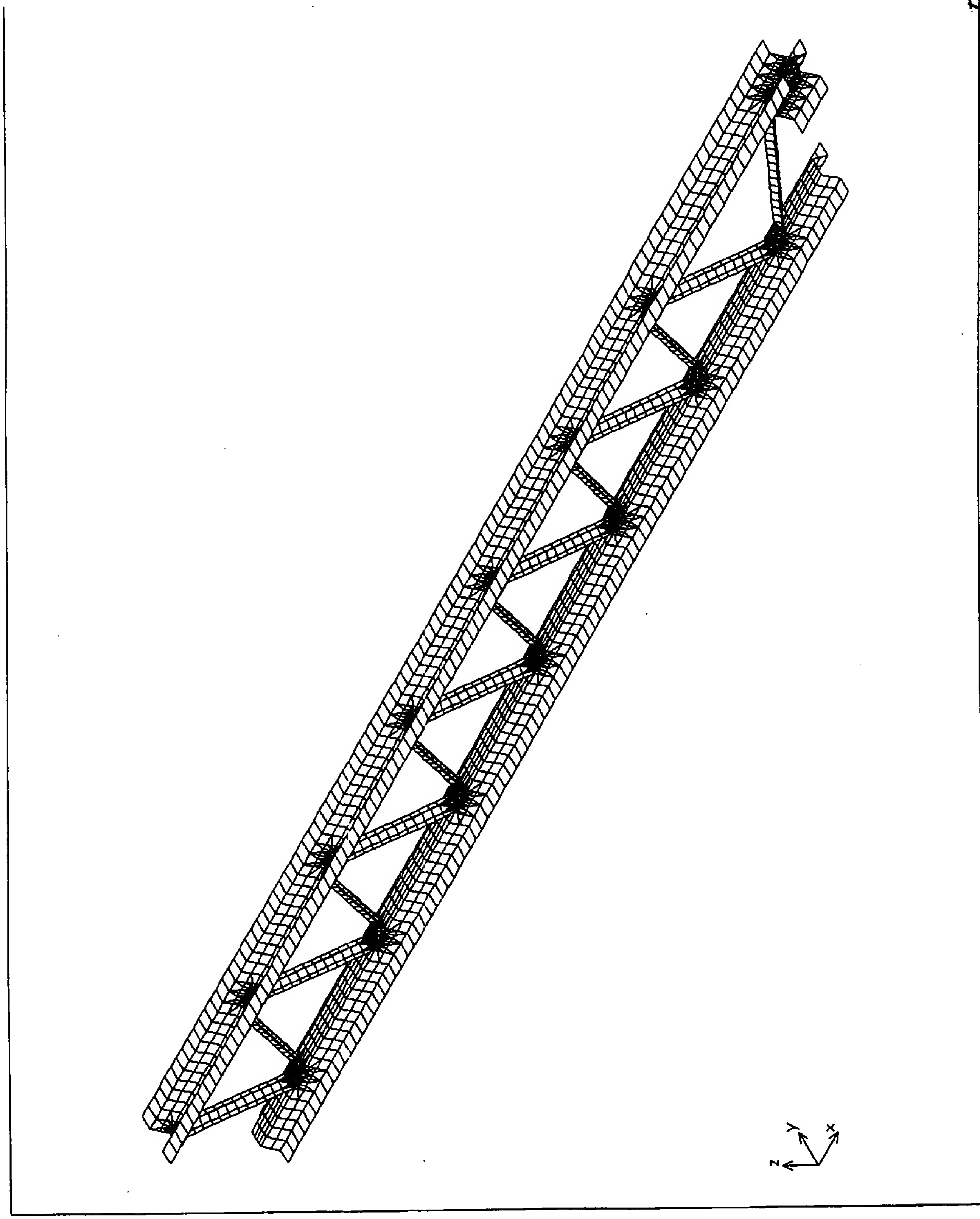
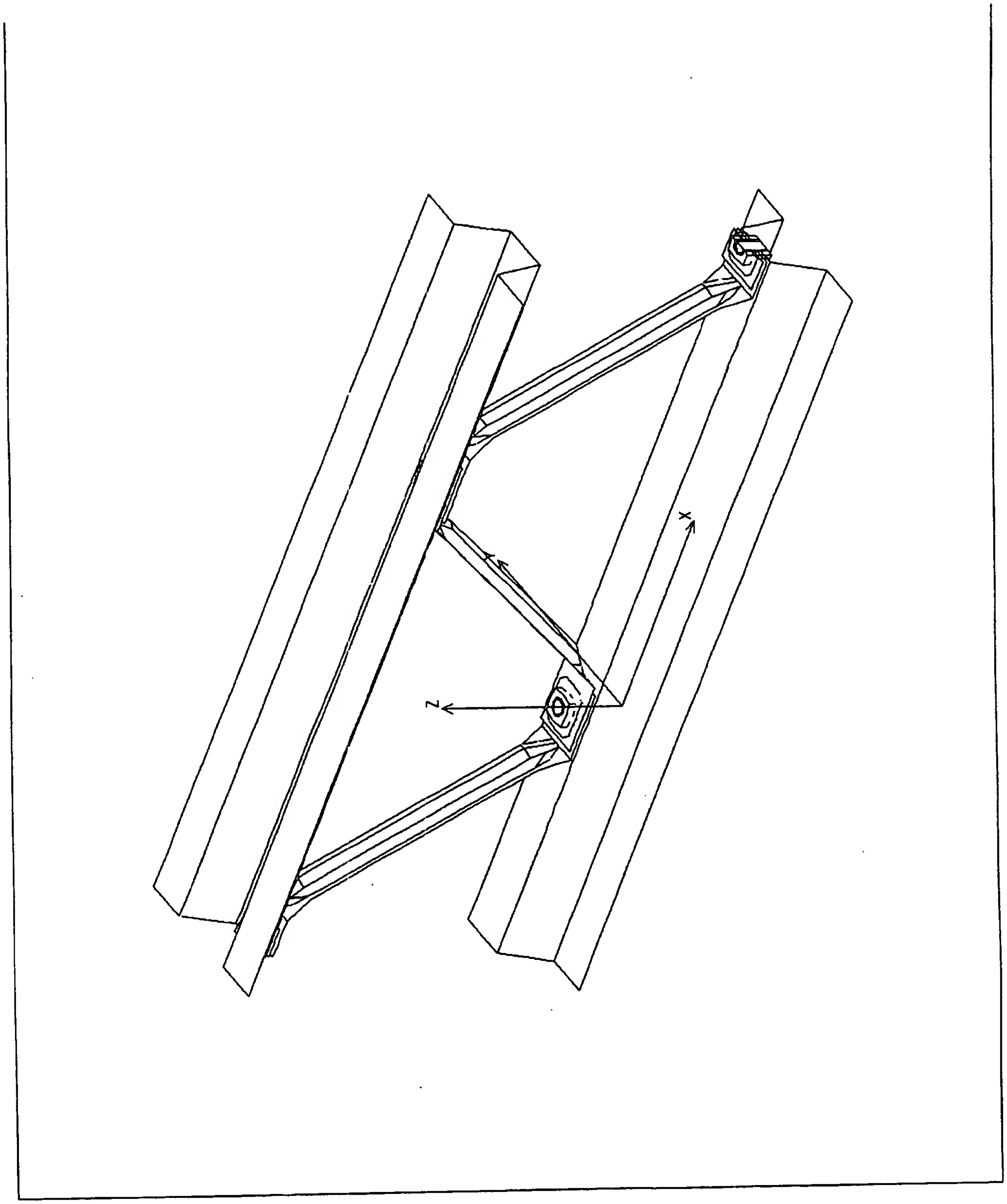


Fig 2,3



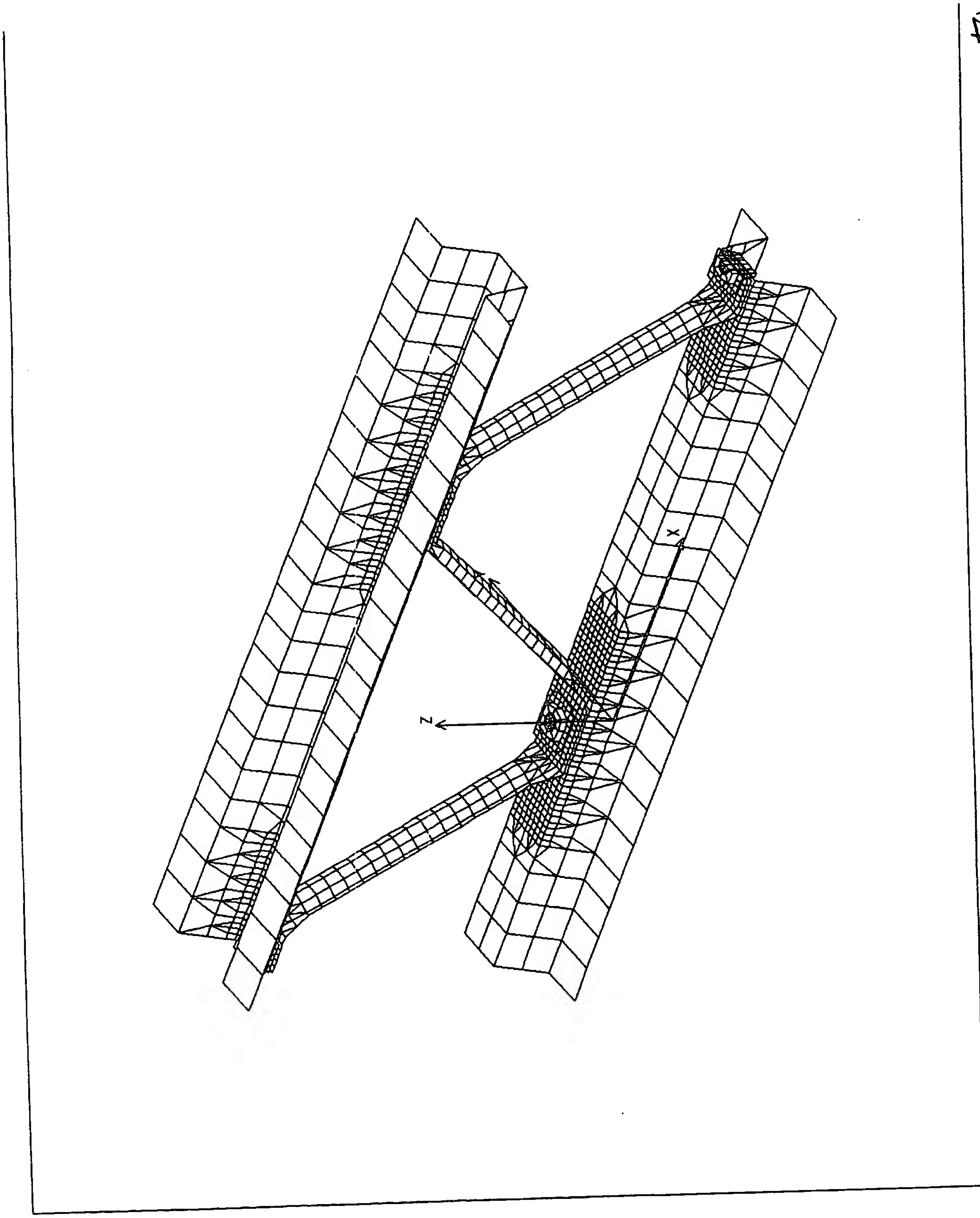


Fig. 2,4

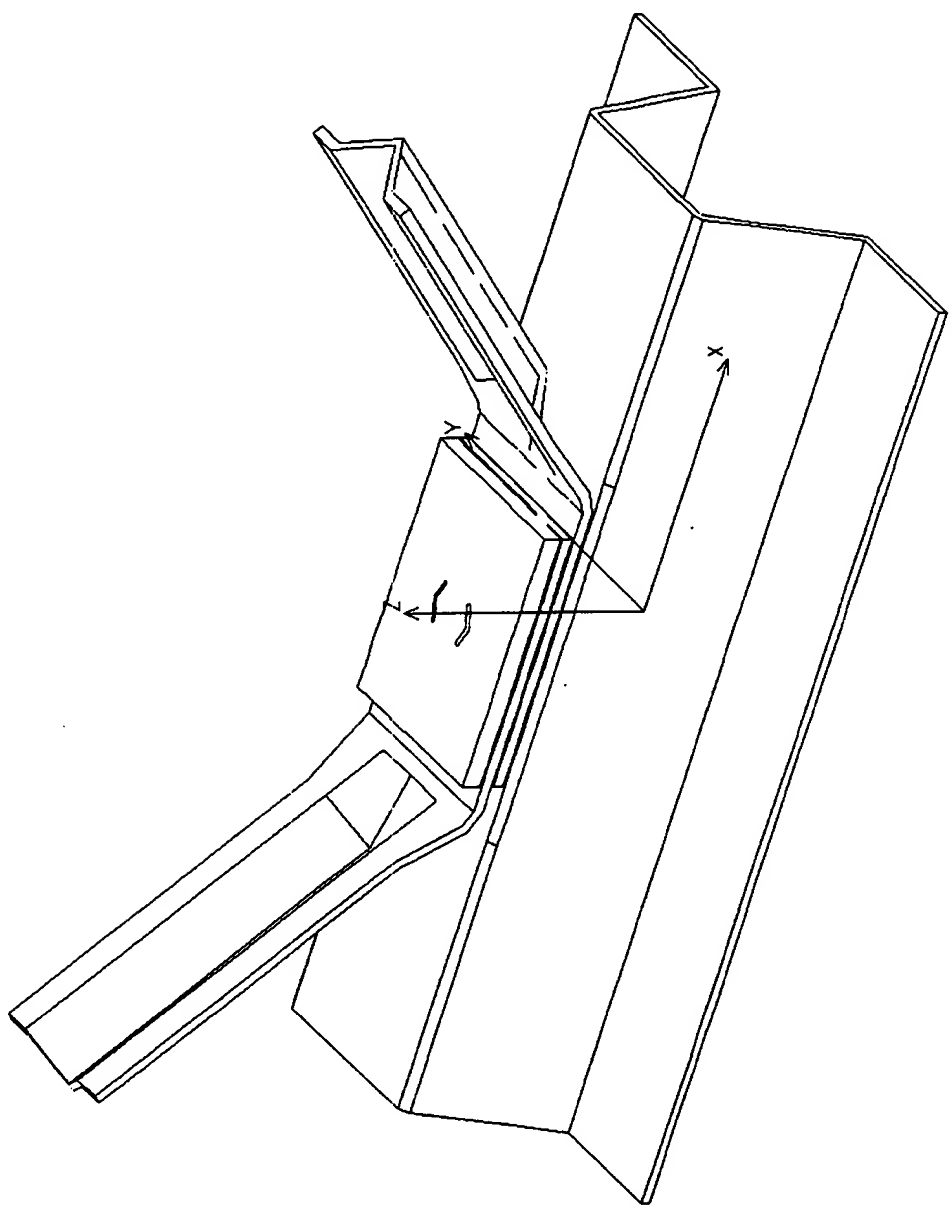
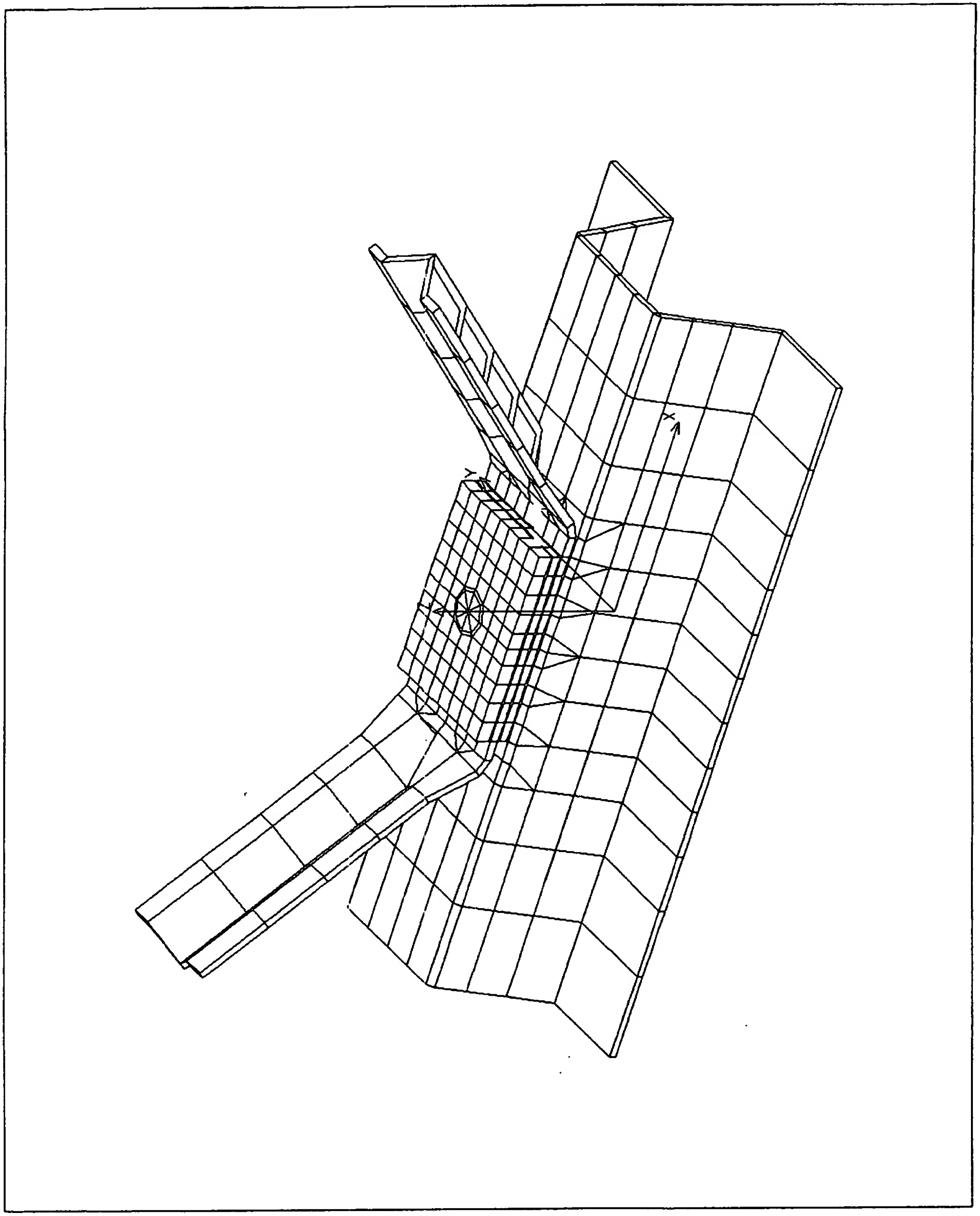


Fig 25

Fig. 26



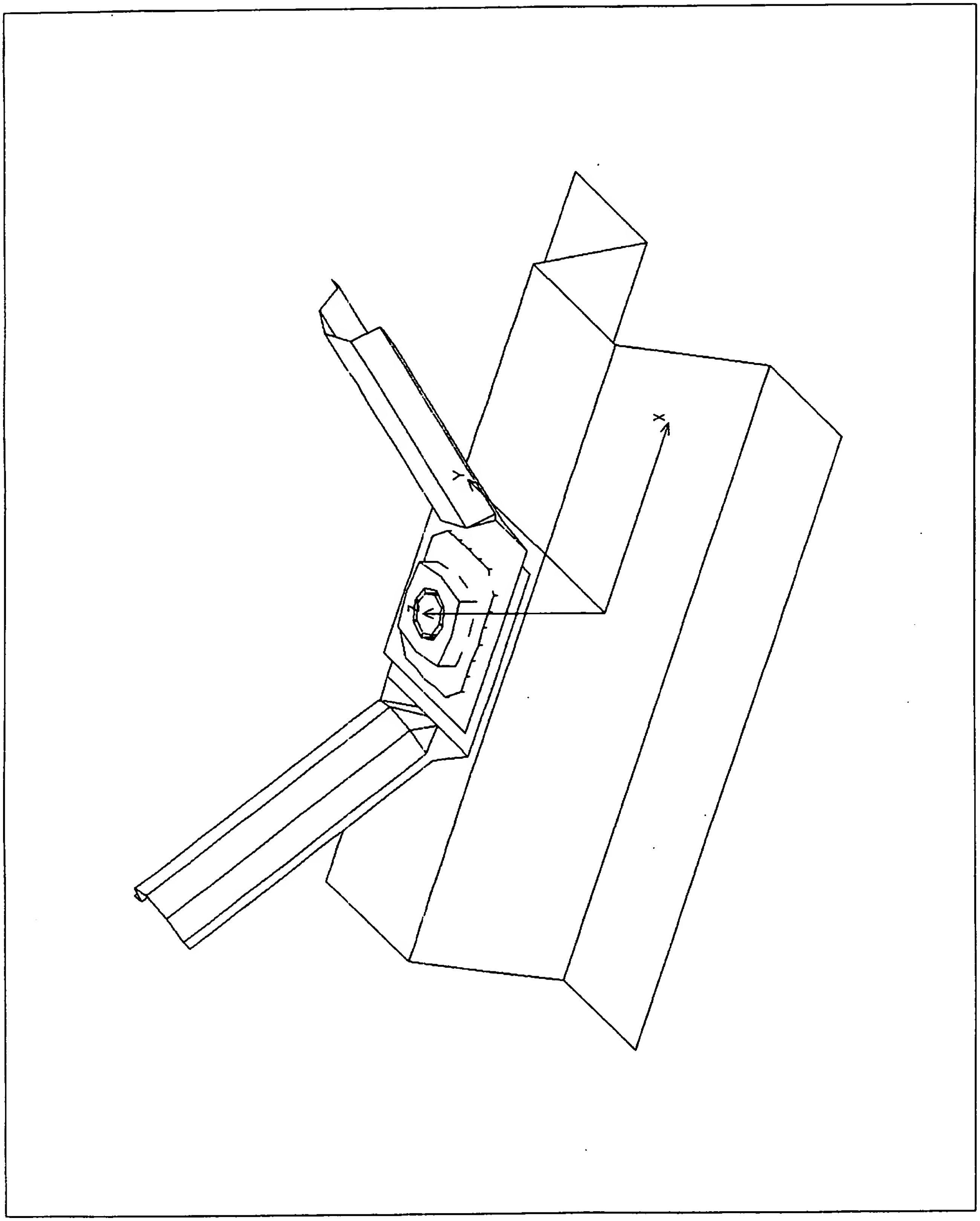
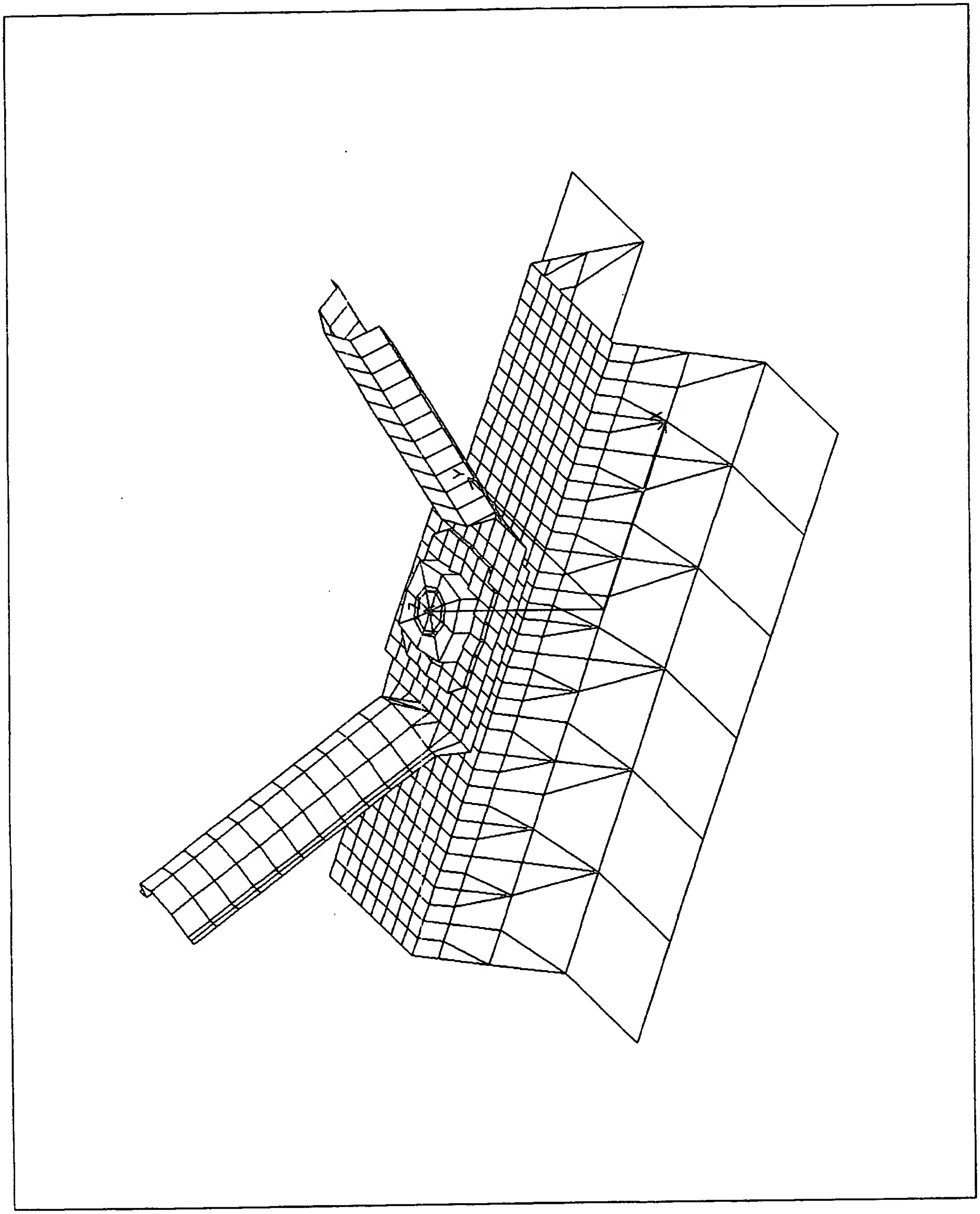


Fig. 27

Fig. 2,8



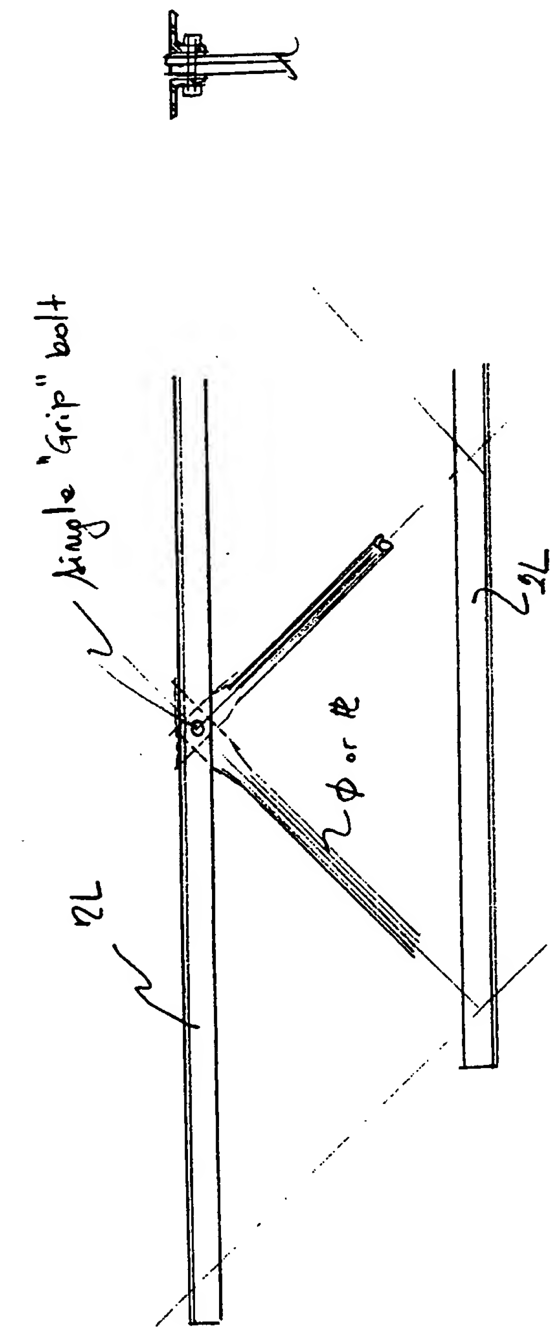


Fig. 3

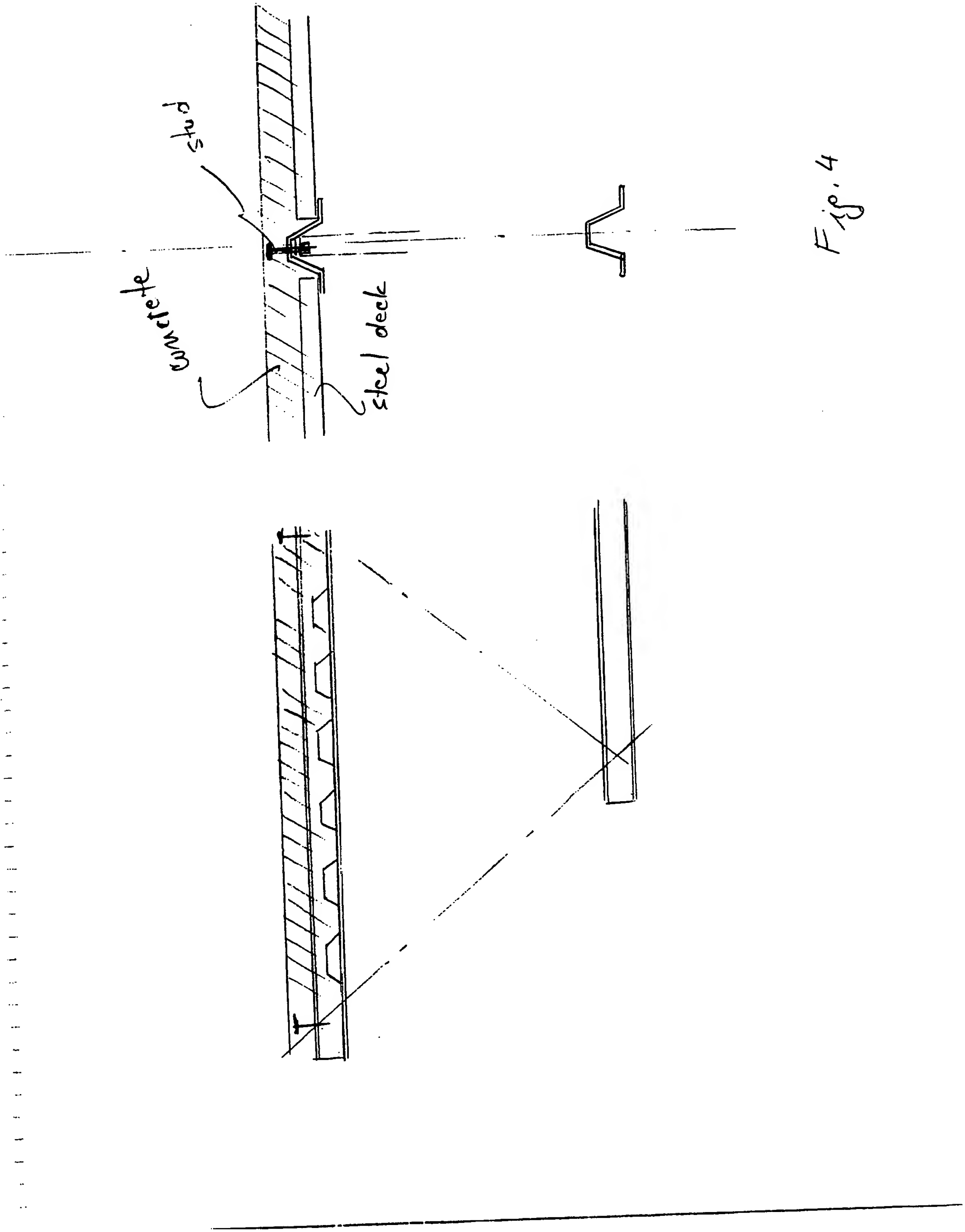


Fig. 4